

Claims

- [c0001] 1. A method of making a high-density circuit module, the method comprising the steps of:
- (a) providing a first CSP having an upper surface and a lower surface with first CSP contacts rising above the lower surface, the upper surface having an extent defined by first and second edges of the first CSP;
 - (b) disposing a first form standard above the upper surface of the first CSP such that at least one portion of the form standard extends downward outside of the lateral extent of the upper surface of the first CSP;
 - (c) placing the first CSP above flex circuitry such that the first CSP contacts are in contact with a plurality of lower flex contacts of the flex circuitry;
 - (d) wrapping the flex circuitry partially about the first form standard such that at least a portion of a lower surface of the flex circuitry is inverted and faces upward above the first form standard, the flex circuitry being fixed to the first form standard;
 - (e) providing a second CSP having an upper surface and a lower surface with second CSP contacts rising above the lower surface, the upper surface having a lateral extent defined by first and second edges of the second CSP;

(f) placing the second CSP adjacent to the portion of the flex circuitry disposed above the first form standard such that the second CSP contacts of the second CSP are in contact with a plurality of upper flex contacts of the flex circuitry accessible within recesses through the portion of the lower surface of the flex circuitry that is inverted and faces upward above the first form standard;

(g) placing a second form standard adjacent to the upper surface of the second CSP such that at least one portion of the second form standard extends downward outside of the lateral extent of the second CSP.

[c0002] 2. The method of claim 1 in which the second form standard and the flex circuitry are thermally connected.

[c0003] 3. The method of claim 1 in which the flex circuitry comprises at least one flex circuit having first and second conductive layers, the first conductive layer being closer to the first CSP than is the second conductive layer subsequent to the step of wrapping the flex circuitry partially about the first form standard, between which layers there is an intermediate layer, the second conductive layer having demarked selected ones of the upper and lower flex contacts.

[c0004] 4. The method of claim 1 in which the flex circuitry comprises at least one flex circuit having first and second

conductive layers, the first conductive layer being closer to the first CSP than is the second conductive layer subsequent to the step of wrapping the flex circuitry partially about the first form standard, between which layers there is an intermediate layer, the first conductive layer having demarked selected ones of the upper and lower flex contacts.

[c0005] 5. The method of claim 1 in which in which the flex circuitry comprises a conductive layer that expresses the upper and lower flex contacts for connection of the second and first CSPs, respectively.

[c0006] 6. The method of claim 1 in which the flex circuitry has first and second conductive layers, between which there is an intermediate layer.

[c0007] 7. The method of claim 1 further including the step of securing the flex circuitry to the first form standard with adhesive.

[c0008] 8. The method of claim 1 further including the step of securing the first form standard to the flex circuitry with thermally conductive adhesive and in which the first form standard comprises thermally conductive material.

[c0009] 9. The method of claim 1 further including the step of securing the first form standard to the first CSP with ad-

hesive.

[c0010] 10. The method of claim 1 further including the step of securing the first form standard to the first CSP with thermally conductive adhesive, the first form standard further comprising thermally conductive material.

[c0011] 11. The method of claim 1 further including the step of attaching a set of module contacts to the flex circuitry by passing selected ones of the module contacts through module contact windows to contact selected ones of the lower flex contacts.

[c0012] 12. The method of claim 1 in which the form standard presents at least one curved surface for contact with the flex circuitry.

[c0013] 13. A method of making a high-density circuit module, the method comprising the steps of:

- (a) providing a first CSP, the first CSP having a first and a second edge, the edges bounding an upper and a lower major surface and delineating a lateral extent for the upper major surface;
- (b) bonding a form standard adjacent to the upper major surface of the first CSP such that at least one portion of a lower major surface of the form standard is attached to the upper surface of the first CSP and an at least one

form curve portion of the form standard extends outside of a lateral extent of the upper major surface;

(c) placing flex circuitry in contact with a first set of CSP contacts along the lower major surface of the first CSP;

(d) wrapping the flex circuitry partially about the at least one form curve portion of the form standard such that portions of a lower surface of the flex circuitry are inverted and face upward at a location above the form standard;

(e) electrically connecting a second set of CSP contacts on a second CSP to respective ones of the upper flex contacts.

[c0014] 14. The method of claim 13 further including the step of securing the form standard to the first CSP with thermally conductive adhesive, the form standard comprising thermally conductive material.

[c0015] 15. The method of claim 13 further including the step of attaching a set of module contacts to the flex circuitry by passing selected ones of the module contacts through module contact windows to contact selected ones of the lower flex contacts.

[c0016] 16. The method of claim 13 further including the step of electrically connecting a set of module contacts to selected ones of the lower flex contacts of the flex cir-

cuitry.

[c0017] 17. The method of claim 13 further including the step of placing an additional form standard adjacent to an upper surface of the second CSP such that at least one portion of the additional form standard extends outside of a lateral extent of the second CSP and the second form standard is thermally connected to the flex circuitry.

[c0018] 18. The method of claim 13 in which the flex circuitry has first and second conductive layers, between which there is an intermediate layer.

[c0019] 19. The method of claim 13 in which the flex circuitry has first and second conductive layers.

[c0020] 20. The method of claim 13 further including the step of securing the form standard to the flex circuitry with adhesive.

[c0021] 21. A method of making a high-density circuit module, the method comprising the steps of:

- (a) placing flex circuitry in contact with a first set of CSP contacts along a lower major surface of a first CSP;
- (b) placing a form standard above an upper surface of a first CSP such that at least one curved portion of the form standard extends outside of a lateral extent of the CSP to present at least one curved outer surface;

(c) wrapping the flex circuitry partially about the at least one curved portion of the form standard to create wrapped flex circuitry disposed about the at least one curved outer surface of the at least one curved portion of the form standard such that the flex circuitry presents a plurality of upper flex contacts above the form standard and a plurality of lower flex contacts below a lower surface of the first CSP;

(d) electrically connecting a second set of CSP contacts on a second CSP second CSP to respective ones of the upper flex contacts.

[c0022] 22. The method of claim 21 in which the step of wrapping the flex circuitry includes wrapping the flex circuitry partially about two curved outer surfaces of two curved portions of the form standard, the two curved portions extending at least partially past two opposite lateral sides of the CSP.

[c0023] 23. The method of claim 21 further including the step of attaching a set of solder ball module contacts to a selected ones of the lower flex contacts such that the solder ball module contacts are presented below the flex circuitry for connection of the module to its operating environment.

[c0024] 24. The method of claim 21 in which the at least one

curved portion of the form standard extends downward after the step of placing the form standard on top of the first CSP.

[c0025] 25. The method of claim 21 in which the flex circuitry has first and second conductive layers.

[c0026] 26. The method of claim 21 further including the step of securing the form standard to a body of the first CSP with thermally conductive adhesive, the form standard comprising thermally conductive material.

[c0027] 27. A method of making a high-density circuit module, the method comprising the steps of:

(a) providing a first CSP with an upper major surface and a lower major surface, the lower major surface having a plurality of first CSP contacts;

(b) placing an angular cap on the first CSP such that the angular cap rests upon the upper major surface of the first CSP;

(c) wrapping flex circuitry partially around the angular cap and the first CSP such that a first set of flex contacts of the flex circuitry are connected to a set of first CSP contacts on a bottom surface of the first CSP and a second set of flex contacts of the flex circuitry are exposed above the angular cap and the first CSP;

(d) connecting a second CSP to the second set of flex

contacts of the flex circuitry.

[c0028] 28. The method of claim 27 further including the step of securing the flex circuitry to the angular cap with adhesive.

[c0029] 29. The method of claim 28 in which the adhesive is thermally conductive and the angular cap comprises a thermally conductive material.

[c0030] 30. The method of claim 27 in which the flex circuitry has first and second conductive layers, between which there is an intermediate layer.

[c0031] 31. The method of claim 27 in which in which the flex circuitry comprises at least one flex circuit having first and second conductive layers, between which there is an intermediate layer.